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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Stephan G. Meier

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MHKKG / GLOBALFOUNDRIES

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EXAMINER

DILLON, SAMUEL A

ART UNIT

PAPER NUMBER

2185

NOTIFICATION DATE

DELIVERY MODE

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ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/653,754	Applicant(s) MEIER ET AL.	
	Examiner SAMUEL DILLON	Art Unit 2185	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 May 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-13 and 15-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-13 and 15-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on May 17, 2010 has been entered. Per the amendment, Claims 1, 3, 13, 15 and 23 have been amended.

I. RESPONSE TO AMENDMENT(S) / ARGUMENT(S)

2. Per the instant amendment, the 35 U.S.C. 112 second paragraph rejections of Claims 1, 3-13 and 15-29 have been withdrawn.

3. Applicant's arguments with respect to the 35 U.S.C. 102(b) and 103(a) rejections of Claims 1, 3-13 and 15-29 have been fully considered and are **persuasive**, but are moot in view of the new ground(s) of rejection, as described below.

4. Regarding all other Claims not specifically traversed above and whose rejections were upheld, the Applicant contends that the listed claims are allowable by virtue of their dependence on other allowable claims. As this dependence is the sole rationale put forth for the allowability of said dependent claims, the Applicant is directed to the Examiner's remarks above. Additionally, any other arguments the Applicant made that were not specifically addressed in this Office Action appeared to directly rely on an argument presented elsewhere in the Applicant's response that was traversed, rendered moot or found persuasive above.

II. OBJECTIONS TO THE CLAIMS

5. Claims 1, 13 and 23 read “*and the of the plurality of values*” and should be amended to read “*and the ~~of the~~ plurality of values*”.

III. REJECTIONS BASED ON PRIOR ART

Claim Rejections - 35 USC ' 102 - Wang

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. **Claims 1, 3-11, 13, 15-21, 23, 24 and 29** are rejected under 35 U.S.C. 102(b) as being anticipated by Wang (*US Patent 5,956,746*).
8. As per **Claims 1 and 13**, but more specifically to Claim 1, Tran discloses a way predictor comprising:

a decoder (*address register, fig 4*) that decodes an indication (*set, bits 5-15, fig 4*) of a first address (*address in the address register, fig 4*) that is to access a cache (*off-processor cache memory, col 2 lns 5-19*) for a current cache access during use, the decoder selecting a set responsive to the indication of the first address during use (*such as set 84, fig 4*);

a memory (*predictor tag array, fig 4*) coupled to the decoder, wherein the memory outputs a plurality of values (*W0 through W3, fig 4*) from a set of storage locations in response to the decoder selecting the set during use, wherein each of the plurality of values corresponds to a different way of a plurality of ways of the memory (*W0 through W3, fig 4*), wherein the cache includes a same number of ways as the memory (*4 ways because cache is 4-way set associative, col 3*

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Ins 53-57), and wherein the cache includes a tag memory storing a plurality of tags corresponding to cache lines stored in the cache (*remaining tag information, col 3 Ins 1-15*) and a data memory storing the cache lines during use (*off-processor cache memory, col 2 Ins 5-19*), wherein each of the plurality of values comprises a plurality of bits (*4-bits, col 3 Ins 58-67*), and wherein each value is associated with a different corresponding cache line stored in the cache in a respective way of the plurality of ways (*col 4 Ins 34-45*), and wherein the different corresponding cache line is stored in the set selected by the decoder (*col 4 Ins 34-45*), and wherein there is a one-to-one correspondence between the different corresponding cache lines and the of the plurality of values (*4 ways per set, fig 4 and col 4 Ins 34-45*), and the plurality of bits forming a given value of the plurality of values, as a whole, is the value associated with the different cache line (*col 3 Ins 58-67*); and

a circuit (*comparator, fig 4*) coupled to receive the plurality of values and a first value (*bits 16-19 of the address register, fig 4*) corresponding to the first address and the first value comprising the plurality of bits, wherein the circuit compares the first value to the plurality of values during use (*comparator compares, fig 4*), and wherein a match of the first value and a second value stored in a first way of the plurality of ways causes the circuit to predict the first way be a hit in the cache for the first address for the current access during use (*col 4 Ins 10-18*), and wherein the circuit outputs a way identifier identifying the first way to the data memory during use (*way prediction signals, fig 4*), the way identifier used by the data memory to select the first way to output data during use (*col 4 Ins 17-22*), and wherein the circuit constructs the way identifier based

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on the comparisons of the first value to the plurality of values during use (*2-bit signal is output, col 4 lns 10-15*).

9. For **Claims 3 and 15**, but more specifically to Claim 3, Wang discloses the circuit, responsive to none of the plurality of values matching the first value in the current cache access, asserts an early miss signal during use, wherein the early miss signal indicates that the first address is a miss in the cache for the current cache access prior to a tag comparison between the first address and the plurality of tags for the current cache access (*none of the four numbers matching causes there to be inherently some signal issues that causes the processor to look elsewhere, col 4 lns 8-11*).

10. For **Claim 4 and 16**, but more specifically to Claim 4, Wang discloses each of the plurality of values comprises a portion of a tag identifying a corresponding cache line in the cache, the portion excluding at least one bit of the tag (*col 3 lns 31-44*).

11. For **Claim 5 and 17**, but more specifically to Claim 5, Wang discloses each of the plurality of values is derived from at least a portion of the indication of the address identifying a corresponding cache line (*col 3 lns 31-44*).

12. For **Claim 6 and 18**, but more specifically to Claim 6, Wang discloses each of the plurality of values comprises a portion of one or more address operands used to generate the address (*col 3 lns 31-44*).

13. For **Claim 7 and 19**, but more specifically to Claim 7, Wang discloses at least one bit of one of the plurality of values is a logical combination of two or more bits of the address (*any bit could be considered as being a logical combination of two other bits if the logical combination is not defined, col 3 lns 31-44*).

14. For **Claim 8 and 20**, but more specifically to Claim 8, Wang discloses at least one bit of one of the plurality of values is a logical combination of two or more bits of one or more address operands used to generate the address (*any bit could be considered as*

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being a logical combination of two other bits if the logical combination is not defined, col 3 Ins 31-44).

15. For **Claim 9 and 21**, but more specifically to **Claim 9**, Wang discloses the indication of the first address comprises at least a portion of the first address (*fig 4*).

16. For **Claim 10**, Wang discloses the indication of the first address comprises two or more address operands used to generate the first address (*address register, fig 4*).

17. For **Claim 11**, Wang discloses if the way prediction is incorrect, the cache replaces a cache line in the way indicated by the way prediction with a missing cache line corresponding to the first address during use (*col 4 Ins 7-11*).

18. For **Claim 23**, Wang discloses an apparatus comprising the way predictor of **Claim 1**, and the data cache data memory coupled to the way predictor (*by way of the cache controller, fig 3*), wherein the data cache data memory is arranged into the plurality of ways (*col 4 Ins 34-45*), and wherein the data cache data memory outputs data from the first way during use (*col 5 In 66 to col 6 In 2*), and wherein the data cache data memory includes a second circuit that reduces power consumption attributable to one or more non-predicted ways of the plurality of ways during use (*if none of the four numbers match, a cache miss is detected without having to compare against the remaining tag bits, col 4 Ins 7-11*).

19. For **Claim 24**, Wang discloses the data cache tag memory outputting a tag from the first way and not outputting tags from the one or more non-predicted ways during use (*the predicted way has the remaining tag compared against, the non-predicted ways do not, col 5 In 66 to col 6 In 2*).

20. For **Claim 29**, Wang discloses the apparatus further comprising a second level cache (*the Examiner takes official notice that cache hierarchies are well known in the art, and that it would have been obvious to include a lower level cache for the benefit of*

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additional caching), and wherein the circuit detects a miss responsive to the plurality of values and the first value prior to the miss being detected in the cache that corresponds to the data cache data memory during use (*col 4 lns 7-11*), and wherein the circuit signals the miss to the second level cache during use, and wherein the second level cache begins an access corresponding to the first address responsive to signal from the circuit during use (*per above, cache misses propagate down the hierarchy to a lower level cache*).

Claim Rejections - 35 USC ' 103 – Wang and Tran

21. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

22. **Claims 25-28** are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (*US Patent 5,956,746*) in view of Tran (*US Patent 6,115,792*).

23. For **Claim 25**, Wang discloses the apparatus of Claim 23, but for the purposes of this rejection does not disclose the further limitations of Claim 25. Wang discloses the output of a comparison picking which of a plurality of possible 2-bit values are chosen to be output as a way prediction (*col 4 lns 1-22*), but does not disclose how this is done.

Tran discloses generating separate wordlines for each of a plurality of ways in a data cache data memory during use, and wherein a second circuit activates a first wordline to the first way and to not activate word lines to the non-predicted ways during use (*the Row Drive(n)'s pick word lines based on the predicted way from the set of word lines that could be outputted, figure 5*).

Wang and Tran are analogous art in that they deal with way prediction. At the time of the invention, it would have been obvious to modify Wang to use Tran's wordline activation system to select the way to output. The motivation for doing so would have been that it combines prior art elements according to known methods to yield predictable results. Therefore, it would have been obvious to modify Wang per the teachings of Tran to obtain the invention of Claim 25.

24. For **Claim 26**, Wang and Tran discloses the second circuit includes column multiplexor circuitry (*Tran, column select 82 and element 84 and the like, figure 5*) coupled to the plurality of ways, wherein the column multiplexor circuitry selects the output of the first way as input to a sense amplifier circuit, wherein the column multiplexor circuitry is controlled by the predicted first way (*one of the inputs is a result of the predicted first way, so can be said to be controller by said way, figures 4 and 5*).

25. For **Claim 27**, Wang and Tran discloses the second circuit includes column multiplexor circuitry (*Tran, column select 82 and element 84 and the like, figure 5*) coupled to the plurality of ways, wherein the column multiplexor circuitry selects the output of the first way as input to a sense amplifier circuit during use, wherein the column multiplexor circuitry is controlled by the predicted first way (*Tran, one of the inputs is a result of the predicted first way, so can be said to be controller by said way, figures 4 and 5*).

26. For **Claim 28**, Wang and Tran discloses the second circuit comprises a plurality of sense amplifier circuits (*Tran, col. 14 lines 5-16*), wherein each of the plurality of sense amplifier circuits is coupled to a respective one of the plurality of ways, and wherein each of the plurality of sense amplifier circuits includes an enable input that is controlled by the predicted first way (*Tran, figures 4 and 5*).

Claim Rejections - 35 USC ' 103 – Wang and Wickeraad

27. **Claims 12 and 22** are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (*US Patent 5,956,746*) in view of Wickeraad et al (*US Patent No. 6,490,654*).

28. For **Claims 12 and 22**, but more specifically to Claim 12, Wang fails to disclose if no way prediction is generated and a cache miss results for the first address, the cache uses a replacement algorithm to select the cache line to be replaced with the missing cache line during use. Wickeraad discloses a cache memory replacement algorithm that replaces cache lines based on the likelihood that cache lines will not be needed soon (*col. 4, lines 50- 52*).

Wang and Wickeraad are analogous art in that they are of the same field of endeavor, that is, a system and/or method of memory control. Wickeraad suggests that it would have been desirable to incorporate a cache line replacement algorithm into the system of Wang because this allows data which is likely needed soon is assigned a higher replacement class, while data that is more speculative and less likely to be needed soon is assigned a lower replacement class (*col. 5, lines 2-6*). Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Wang as suggested by Wickeraad to incorporate the feature as claimed.

29. The Examiner has pointed particular references contained in the prior art of record in the body of this action for the convenience of the Applicant. Although the specified citations are representative of the teachings in the art and are applied to the specific limitations within the individual claim, other passages and figures may apply. The Applicant, in preparing the response, should consider fully the entire reference as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner.

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IV. CLOSING COMMENTS

a. STATUS OF CLAIMS IN THE APPLICATION

30. The following is a summary of the treatment and status of all claims:

a(1). CLAIMS NO LONGER IN THE APPLICATION

31. Claims 2 and 14 were cancelled by amendment.

a(2). CLAIMS REJECTED IN THE APPLICATION

32. Claims 1, 3-13 and 15-29 are subject of a non-final action.

b. DIRECTION OF FUTURE CORRESPONDENCES

33. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sam Dillon whose telephone number is 571- 272-8010. The examiner can normally be reached on 9:30-6:00.

34. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sanjiv Shah can be reached on 571-272-4098. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

IMPORTANT NOTE

35. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Sam Dillon
Examiner
Art Unit 2185

/Hong Kim/

Primary Examiner, Art Unit 2185